

TRANSVAGINAL SONOGRAPHIC CRITERIA FOR THE DIAGNOSIS OF ADENOMYOSIS BASED ON HISTOPATHOLOGIC CORRELATION

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SUMMARY

Objective: To evaluate the accuracy of different transvaginal sonographic criteria in the diagnosis of adenomyosis, and to determine the most useful sonographic feature by comparison with histopathologic results.

Materials and Methods: A total of 213 consecutive patients scheduled for hysterectomy underwent preoperative transvaginal sonography in this retrospective study. The diagnosis of adenomyosis was made if one or more of the following sonographic findings were present: (1) a globular uterine configuration; (2) poor definition of the endometrial-myometrial interface; (3) sub-endometrial echogenic linear striations; (4) myometrial anterior-posterior asymmetry; (5) myometrial cysts; and (6) a heterogeneous myometrial echotexture. These sonographic findings were then compared with the histopathologic findings.

Results: The prevalence of adenomyosis was 39.9%. The sensitivity, specificity, positive and negative predictive values, and accuracy of transvaginal ultrasound for the diagnosis of adenomyosis were 87.1, 60.1, 59.2, 87.5 and 70.9%, respectively. We found that subendometrial echogenic linear striations, a heterogeneous myometrial echotexture, and myometrial anterior-posterior asymmetry showed greater accuracy for the diagnosis of adenomyosis. Further evaluation of these findings showed that subendometrial echogenic linear striations had the best sensitivity, and positive and negative predictive values for the diagnosis of uterine adenomyosis (91.8, 67.8 and 92.9%, respectively). The presence of a globular uterine configuration was the most specific sonographic feature (78.1%), but showed poor specificity (50.6%).

Conclusion: The presence of subendometrial echogenic linear striations, a heterogeneous myometrial echotexture, and myometrial anterior-posterior asymmetry on transvaginal ultrasonography supports the diagnosis of adenomyosis. Among the transvaginal ultrasonographic findings consistent with the diagnosis of adenomyosis, subendometrial linear striations had the highest diagnostic accuracy. [*Taiwan J Obstet Gynecol* 2010;49(1):40-44]

Key Words: adenomyosis, linear striation, transvaginal sonography

Introduction

Adenomyosis is a conventional gynecologic disorder referring to the ectopic endometrial glands and stroma within the uterine myometrium [1]. Patients with

adenomyosis may have nonspecific symptoms, including dysmenorrhea, dyspareunia and menometrorrhagia. The possible mechanism of adenomyosis is a result of down-growth and invagination of the basalis endometrium into the myometrium, which may be associated with weakness of the myometrium caused by trauma, such as cesarean section, dilatation and curettage, myomectomy, or other uterine surgeries [2].

Adenomyosis may be diagnosed using transabdominal ultrasonography, transvaginal ultrasonography (TVS) or magnetic resonance imaging (MRI). Transabdominal ultrasonography has a limited diagnostic



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capacity for adenomyosis, while TVS has feasible ability to diagnose adenomyosis [3,4]. As compared with MRI, TVS is more cost-effective and available [5–7].

Several sonographic features have been reported for adenomyosis [8]: (1) heterogeneous myometrium; (2) myometrial cysts; (3) subendometrial echogenic linear striations; (4) globular configuration; (5) myometrial anteroposterior asymmetry; and (6) poor identification of the endometrial junction. However, there is currently no agreement on the most specific transvaginal ultrasound diagnostic feature.

The aim of this retrospective study was to compare different diagnostic criteria of TVS examination, including sensitivity, positive predictive value (PPV), negative predictive value (NPV), and accuracy in the different diagnostic criteria of uterine adenomyosis.

Materials and Methods

Between January 2006 and December 2007, 213 consecutive patients who were scheduled for hysterectomy at our hospital had TVS before surgery. The indications for hysterectomy were dysmenorrhea, menometrorrhagia, cervical intraepithelial neoplasia, adnexal masses, genital prolapse, and endometrial hyperplasia or carcinoma.

TVS examinations were evaluated using a LOGIQ 9 system (GE Healthcare, Milwaukee, WI, USA) with a 7–9 MHz endovaginal probe. All images were restored in the picture archiving and communication system (PACS) also provided by GE Healthcare. The same investigator with 5 years of experience in female pelvic sonography interpreted each picture. During each sonographic examination, the myometrial echotexture, uterine borders (regular or irregular), uterine size, and the presence of associated abnormalities (including leiomyomata) were noted. The diagnostic criteria of uterine adenomyosis include one or more of the following criteria on TVS [1,3,6,9,10]: (1) a globular rounded configuration of the uterus (defined as a regularly enlarged uterus); (2) asymmetry of the anteroposterior wall of the myometrium; (3) poor definition of the endometrial-myometrial junction; (4) myometrial cysts (defined as a round anechoic area with a diameter of 1–7 mm); (5) hyperechoic, subendometrial, echogenic linear striations being located near the endometrial-myometrial interface; and (6) a heterogeneous myometrium (defined by the presence of an indistinctly defined myometrial area with decreased or increased echogenicity). All of the results were re-evaluated by the authors for confirmation.

A histopathologic examination was performed by a gynecologic pathologist, who was blinded to the sonographic findings. Uterine size and fundal, anterior,

posterior, right and left maximal uterine wall thickness were measured. The macroscopic appearance and associated pathologic abnormalities were also recorded. Based on the myometrial thickness, the number of slides ranged from four to eight. Macroscopically, adenomyosis was diagnosed by an enlarged uterus, a globular and/or asymmetrical uterus, and a dense, irregularly fasciculated myometrium with small cavities (0.5–10 mm). Adenomyoma was defined as a circumscribed nodular lesion. Focal adenomyosis (localized adenomyosis) was defined by the presence of adenomyotic lesions restricted to one uterine wall. Histopathologic diagnostic criteria for adenomyosis was the presence of ectopic endometrial gland or tissue within the myometrium and located 2.5 mm beyond the endometrial-myometrial junction. Adenomyosis was graded in accordance with the depth of myometrial involvement. Grades 1, 2 and 3 corresponded to adenomyotic involvement of the inner one-third, two-thirds and entire myometrium, respectively. Adenomyosis was also graded as mild, moderate or severe according to the number of endometrial islets observed (one to three, four to nine, and 10 or more foci, respectively).

Statistical analysis was performed using SPSS (SPSS Inc., Chicago, IL, USA) for Windows. Student's *t* and Mann-Whitney *U* tests were used for parametric and nonparametric continuous variables, respectively, and the χ^2 test was used for categorical variables. Sensitivity, specificity, NPV, PPV, and accuracy were determined for individual ultrasound findings and for the final diagnosis. Statistical significance was set at $p < 0.05$.

Results

Patient characteristics are shown in Table 1. Patients ranged in age from 27 to 73 years (mean, 44.72 ± 6.83 years; median, 44 years). One hundred and eighty-five women (86.9%) were premenopausal, and 28 women (13.1%) were postmenopausal. No statistically significant difference was found in the mean age, gravidity, and parity. The indications for hysterectomy were dysmenorrhea ($n = 119$), menometrorrhagia ($n = 113$), cervical intraepithelial neoplasia ($n = 21$), adnexal masses ($n = 27$), genital prolapse ($n = 18$), and endometrial hyperplasia or carcinoma ($n = 15$).

The frequency of clinical symptoms was higher in patients with adenomyosis. The proportion of postmenopausal women with myomas was higher in patients without adenomyosis.

Histologic examination showed that the overall prevalence of adenomyosis was 39.9% (85/213). Fifty-seven patients (67.1%) had diffuse adenomyosis and

Table 1. Patient characteristics post-hysterectomy with and without adenomyosis*

Sonographic criteria for adenomyosis	Histopathologic adenomyosis			<i>p</i>
	Yes (<i>n</i> = 85)	No (<i>n</i> = 128)	Total (<i>n</i> = 213)	
Age (yr)	45.66 ± 6.61	44.1 ± 6.93	44.72 ± 6.83	NS
Gravidity	2.69 ± 1.59	2.45 ± 1.45	2.54 ± 1.51	NS
Parity	2.35 ± 1.19	2.12 ± 1.3	2.21 ± 1.26	NS
Patients with dysmenorrhea	82 (96.5)	37 (28.9)	119 (55.9)	< 0.001
Patients with menometrorrhagia	61 (71.8)	52 (40.6)	113 (53.1)	0.004
Patients with myomas	28 [†] (32.9)	65 (50.8)	93 (43.7)	0.047
Menopausal women	5 (5.9)	23 (18.0)	28 (13.1)	0.01

*Data are expressed as mean ± standard deviation or *n* (%); [†]28 patients with combined adenomyosis and myomas. NS = not significant; SD = standard deviation.

Table 2. Comparison of transvaginal ultrasound and histopathologic results for each diagnostic criterion of adenomyosis*

	Histopathologic adenomyosis		<i>p</i>
	Yes (<i>n</i> = 85)	No (<i>n</i> = 128)	
Globular uterine configuration			0.08
Yes	43 (50.6)	28 (21.9)	
No	42 (49.4)	100 (78.1)	
Poor definition of the endometrial-myometrial interface			0.22
Yes	53 (62.4)	41 (32.0)	
No	32 (37.6)	87 (68.0)	
Subendometrial echogenic linear striations			< 0.001
Yes	78 (91.8)	37 (28.9)	
No	7 (8.2)	91 (71.1)	
Myometrial anterior-posterior asymmetry			0.047
Yes	50 (58.8)	32 (25.0)	
No	35 (41.2)	96 (75.0)	
Myometrial cysts			> 0.99
Yes	70 (82.4)	70 (54.7)	
No	15 (17.6)	58 (45.3)	
Heterogeneous myometrial echotexture			0.04
Yes	74 (87.1)	51 (39.8)	
No	11 (12.9)	77 (60.2)	

*Data are presented as *n* (%).

28 patients (32.9%) had focal adenomyosis. The grades of adenomyosis were 1, 2 and 3 in 17, 38 and 30 cases, respectively. Adenomyosis was mild, moderate or severe in 21, 37 and 27 cases, respectively. Other disorders, with or without adenomyosis, included leiomyomas (*n* = 93), cervical intraepithelial neoplasia (*n* = 21), adnexal disease (ovarian cancer and abscesses) (*n* = 27), genital prolapse (*n* = 18), and endometrial hyperplasia or carcinoma (*n* = 15).

TVS was diagnostic of adenomyosis in 125 of the 213 patients, but 74 of these patients (59.2%) had a histopathologic diagnosis of adenomyosis (51 false-positive diagnoses). Of the 88 cases in which none of the TVS diagnostic criteria for adenomyosis were seen, 11 patients (12.5%) had a histopathologic diagnosis

of adenomyosis (i.e. 11 false-negative diagnoses). TVS yielded a diagnosis of adenomyosis in 74 of the 85 women diagnosed histologically. The sensitivity, specificity, PPV and NPV of TVS for the diagnosis of adenomyosis were 87.1, 60.1, 59.2 and 87.5%, respectively. The overall accuracy of TVS was 70.9%.

Table 2 reveals that when comparing each sonographic finding of adenomyosis, subendometrial echogenic linear striations, myometrial anterior-posterior asymmetry and heterogeneous myometrial echotexture had higher statistical significance (*p* < 0.05) than other clinical signs of adenomyosis.

Table 3 shows the sensitivities, specificities, PPVs, NPVs, and accuracy for each of the TVS findings. Subendometrial echogenic linear striations were the

Table 3. Sensitivity, specificity, positive and negative predictive values, and accuracy of transvaginal ultrasound

Sonographic feature	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Globular configuration	50.6	78.1	60.6	70.4	67.1
Poor identification of the endomyometrial junction	62.4	70	56.4	73.1	65.7
Subendometrial echogenic linear striations	91.8	71.1	67.8	92.9	79.3
Myometrial anteroposterior asymmetry	58.8	75	61	73.3	68.5
Myometrial cysts	82.4	45.3	50	79.5	60
Heterogeneous myometrium	87.1	60.1	59.2	87.5	70.9

PPV = positive predictive value; NPV = negative predictive value.

Table 4. Comparison of sensitivity, specificity, and positive and negative predictive values from previous studies with our findings

Study	n	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Siedler et al [15]	80	63	97	71	-
Fedele et al [9]	43	80	74	73	81
Ascher et al [5]	17	52.9	66.6	90	20
Reinhold et al [10]	100	86	86	71	94
Brosens et al [12]	34	86.6	57.9	61.9	84.6
Atzori et al [13]	175	86.6	96.2	68.4	98
Reinhold et al [6]	119	89	89	71	96
Vercellini et al [7]	102	82.7	67	50	90.7
Atri et al [16]	102	81	71	54	90
Bazot et al [1]	120	65	97.5	92.8	88.8
Bazot et al [3]	23/106	80.9/38.4	100/97.5	100/83.3	40/82.9
Kepkep et al [8]	70	80.8	61.4	55.3	84.4
Current study	213	87.1	60.1	59.2	87.5

PPV = positive predictive value; NPV = negative predictive value.

most sensitive criterion (91.8%) and had the highest PPV (67.8%), NPV (92.9%), and accuracy (79.3%) for adenomyosis. Although globular uterine configuration had good specificity (78.1%), the sensitivity was low (50.6%). Subendometrial echogenic linear striations, a heterogeneous myometrial echotexture, and myometrial anterior-posterior asymmetry had a good correlation with the diagnosis of adenomyosis.

Discussion

Adenomyosis is a benign disease of the endometrium with invasion into the myometrium and overgrowth [11]. The reported frequency of adenomyosis varies widely from 8–85% [1,5,6,9,10,12,13]. In our study, the overall prevalence of adenomyosis was 39.9% (85/213). According to Azziz [14], this wide range of values is probably owing to differences in the histologic criteria for the diagnosis of adenomyosis, the degree of care with which pathologic specimens are observed, and the number of blocks of sampling specimens taken. In our study, the method of histologic sections might render an underestimation of the

actual frequency of adenomyosis, with only four to eight blocks sectioned per specimen.

Table 4 compares the sensitivity, specificity, PPV, and NPV of our study with previous studies [1,3,5–7,9,10,12,13,15,16]. The sensitivity and specificity (87.1% and 60.1%, respectively) reported in our study were similar to a previous study [17]. The best tool to diagnose uterine adenomyosis, whether MRI or TVU, is still a debate. According to Ascher et al [5], MRI is significantly better than TVU ($p < 0.02$) for diagnosing adenomyosis. However, Reinhold et al [6,10,18] found that TVU was as accurate as MRI in the diagnosis of uterine adenomyosis. Bazot et al [1] suggested that TVU and MRI have similar accuracy rates for the diagnosis of adenomyosis in the absence of associated disorders. The accuracy of TVU for the diagnosis of adenomyosis could be influenced in part by patient characteristics, such as an enlarged uterus [3]. Since MRI is expensive and not always available [1,5–7], TVU continues to play an important role in the diagnosis of uterine adenomyosis.

The variable accuracy of TVU for the diagnosis of adenomyosis may be because of differences in the main diagnostic criteria used. Heterogeneous myometrial echotexture is the major sonographic criteria used in

most studies [5–7,10,12,10,13]. However, Bazot et al [1,3] suggested that myometrial cysts had the highest specificity for adenomyosis. In this retrospective study, we found that subendometrial linear striations had the best specificity and PPV, and this was consistent with the studies of Atri et al [16] and Kepkep et al [8]. A major strength of our study was the number of cases (213 patients) in the study population compared with previous reports (17–175 patients). However, Kepkep et al [8] commented that the combination of myomas in unselected adenomyosis cases (32.9%) limited the accuracy in this study.

In conclusion, our study suggests that the TVU finding of subendometrial echogenic linear striations, a heterogeneous myometrial echotexture and myometrial anterior–posterior asymmetry have good specificity, PPV and NPV for the diagnosis of uterine adenomyosis. Among these TVU findings, subendometrial linear striations had the highest diagnostic accuracy for recognizing adenomyosis, yielding better results than a heterogeneous myometrium.

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